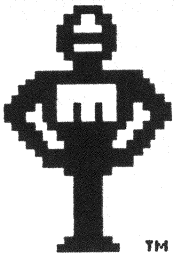
Elementary Algebra

QUADRATIC EQUATIONS



Courses by Computers, Inc.
Educational Courseware

Copyright © 1983 Courses by Computers, Inc.

All rights reserved. No part of this publication may be reproduced, except for review purposes, without written permission from the publisher.

Printed in U.S.A.

Preface

Quadratic Equations is a Courses by Computers educational courseware package. It is available for use with Apple II, Apple II Plus, Apple IIe, and Apple IIc microcomputers.

The **Quadratic Equations** package consists of one double-sided diskette, a supporting manual, and a Student Workbook. The front side of the diskette contains instructional lessons with practice exercises, and the flip side of the diskette contains objective-by-objective tests.

Quadratic Equations is one of ten topics in the *Elementary Algebra* course. Using interactive instructional techniques, the lessons in **Quadratic Equations** lead the student through a series of objectives covering related algebraic skills and concepts. The lessons can be used in a variety of ways. They may be most helpful when used either as supplements to regular classroom instruction or for review and practice.

Hardware Requirements

You will need an Apple II, Apple II Plus, Apple IIe or Apple IIc microcomputer with the following:

- TV or monitor
  (color is recommended but not required)
- 64K memory
- Disk drive and control card for
  DOS 3.3 or ProDOS

Credits

Quadratic Equations was designed and developed by COURSES by COMPUTERS, INC., State College, PA, and is one of a family of products marketed under the title of *Elementary Algebra*.

The graphic character, *Micro*, that appears on the cover and in numerous other places in the product is a trademark of COURSES by COMPUTERS, INC.

Quadratic Equations was developed with the aid of the following equipment and software:

Apple*IIe and Apple*III microcomputers

Apple*II Pascal Products including Pascal OS.INTERP and Pascal Short Graphics Module

These are copyrighted programs of Apple Computer, Inc. licensed to Courses by Computers, Inc. to distribute for use only in combination with **Quadratic Equations**. Apple Software shall not be copied onto another diskette (except for archive purposes) or into memory unless part of the execution of **Quadratic Equations**. When **Quadratic Equations** has completed execution, Apple Software shall not be used by any other program.

APPLE COMPUTER, INC. AND THE REGENTS OF THE UNIVERSITY OF CALIFORNIA MAKE NO WARRANTIES, EITHER EXPRESS OR IMPLIED, REGARDING THE ENCLOSED COMPUTER SOFTWARE PACKAGE, ITS MERCHANTABILITY OR ITS FITNESS FOR ANY PARTICULAR PURPOSE. THE EXCLUSION OF IMPLIED WARRANTIES IS NOT PERMITTED BY SOME STATES. THE ABOVE EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY PROVIDES YOU WITH SPECIFIC LEGAL RIGHTS. THERE MAY BE OTHER RIGHTS THAT YOU MAY HAVE WHICH VARY FROM STATE TO STATE.

*"Apple" is the registered trademark of Apple Computer, Inc.

Distribution Information

For additional information on this and other educational courseware, please write to:

Courses by Computers, Inc.
P.O. Box 830
State College, PA 16804

or

Call 814/234-2210

Additional copies of the Student Workbook for **Quadratic Equations** may be purchased from Courses by Computers, Inc.

Additional sets of diskettes also may be purchased by schools in limited quantities. Call or write to Courses by Computers, Inc. for pricing information.

Contents

1 **Overview** 1
Introduction 2
Tutorial Lessons 2
Testing 4
Prerequisites 4
Features and Benefits 5
Helping the Student Get Started 6
Special Key Functions 7
Entering Fractions 8

2 **Lesson Design** 9
Lesson 1 - Special Cases 10
Lesson 2 - The General Case 12
Lesson 3 - The Quadratic Formula 14

3 **Teaching Strategies** 17
Classroom Integration 17
Individual Support 18
Using the Test Diskette 19
Scoring and Record Keeping 21

4 **Supplementary Materials** 23
Sample Personal Record Sheet 24
Sample Class Record Sheet 25
Glossary 26
Practice Sets 27

Overview 1

The *Elementary Algebra* course is comprised of ten packages, one for each of the following topics:

- Signed Number Operations
- Exponents, Roots, and Radicals
- Polynomials
- Factoring
- Equations and Inequalities
- **Quadratic Equations**
- Rational Expressions
- Graphing Lines on a Plane
- Systems of Equations
- Comprehensive Test

These can be used to support material taught in the algebra classroom. The topics can be used individually or together as a part of most standard algebra courses.

Each of the first nine topics presents a separate set of lessons. Each lesson is designed to help the student achieve one or more specified learning objectives. The flip side of each lesson diskette provides a testing program. There are two kinds of tests: a placement test and a series of mastery tests.

A Comprehensive Test package also is available for the *Elementary Algebra* course. This package contains one diskette for assessing the student's mastery of key objectives within the entire series of topics.

Introduction

Quadratic Equations is the sixth topic in the *Elementary Algebra* course. It contains the following lessons with corresponding tests:

- Lesson 1 - Special Cases
- Lesson 2 - The General Case
- Lesson 3 - The Quadratic Formula

Each lesson addresses one or more objectives. Table 1 shows how the microcomputer-based lessons are organized.

Tutorial Lessons

The lessons are designed to be effective learning tools. The three lessons introduce the student to quadratic equations and the procedures for solving them.

The lessons are arranged in the recommended order of learning.

For each objective in each lesson, at least one example is provided. The examples illustrate, step by step, the concept or skill to be practiced. Then, the student is presented with a set of exercises that provide an opportunity to practice the new skills and concepts. After completing the practice exercises, the student is given a report on how well he or she performed. Finally, the student is given the option to select a second set of practice exercises or continue on to the next objective.

Every lesson provides appropriate feedback to all of the student's responses. The student is praised for correct answers and offered corrective help for incorrect answers.

Table 1. Lesson Organization

Lesson	Subject	Objective
1	Special Cases	1a. Solve quadratic equations of the form: $ax^2 \pm bx = 0$.
		1b. Solve quadratic equations of the form: $x^2 - a^2 = 0$.
2	The General Case	2a. Factorable Forms with Two Solutions - Solve quadratic equations that are factorable over the integers.
		2b. Factorable Forms with One Solution - Solve quadratic equations that are factorable as perfect squares.
3	The Quadratic Formula	3a. Solve quadratic equations using the quadratic formula.

The lessons are interactive and are intended to enhance the student's learning experience with clear and concise text, immediate and encouraging feedback, helpful graphics, and challenging exercises. They are designed to hold the student's attention while allowing the student to proceed through the material at his or her own pace.

The Student Workbook contains exercises to support each of the lessons on the diskette.

Testing

Quadratic Equations has a testing program with the lesson diskette. The tests are on the flip side of the lesson diskette, and there are two kinds of tests. First, there is a placement test to help the teacher determine which objectives a student needs to study or review. Second, there is a series of mastery tests, one test for each of the learning objectives in the lessons. These tests are provided to help the teacher determine whether or not a student has mastered a particular objective.

Prerequisites

Students using the lessons in **Quadratic Equations** should have a thorough understanding of pre-algebra mathematics and the basic algebra concepts necessary to learn quadratic equations. To effectively complete the lessons, the student must be able to perform operations with polynomials, factor polynomials, and solve linear equations.

Features and Benefits

The lessons provide instruction and feedback designed to allow the student to complete the lessons independently at his or her own pace. The lessons also contain the following features to help enhance the student's learning experience:

- Variability - The practice exercises for each objective are drawn from a large bank of items. The items in a set of exercises are randomly selected by the computer. This means that a different set of exercises is presented to the student each time he or she uses the lessons.

- Feedback - The lesson always responds to correct answers with praise and to incorrect answers with corrective help and encouragement. At the beginning of a lesson session, the student is asked to enter his or her name. This allows the instruction to be addressed personally to the student.

- Sound - Sound cues that attract the student's attention are optional. The sound can be turned on or off by pressing CONTROL O. The sound is off when the lesson begins.

- Graphic enhancements - The graphics in **Quadratic Equations** are designed to add interest and clarity to the lessons. In addition, a small robot figure acts as a guide to call the student's attention to each event. If a color TV or monitor is used, the lesson displays will be in color.

Helping the Student Get Started

Scratch paper and a pencil should always be available to assist the student in performing the computations in the practice drills.

The lessons are contained on a flexible diskette that must be inserted into the disk drive. Use the following instructions to load the lessons into an Apple microcomputer.

1. Make sure the microcomputer is off.

2. Insert the diskette into the disk drive and close the door of the drive. Insert the diskette with the label side up for instruction and practice. Turn the diskette over and insert with the label side down for testing.

3. Turn on the microcomputer and the TV or monitor.

4. The title page for the topic will appear on the screen.

If the student is not familiar with the microcomputer, the standard conventions for entering responses may have to be explained. The student also should be aware of the special key functions and entry procedures described on the following two pages.

To end a computer session use the following instructions:

1. Open the door of the disk drive.

2. Remove the diskette from the disk drive and return it to its protective envelope.

3. Turn off the microcomputer and the TV or monitor.

Special Key Functions

To allow for better control of each lesson the following special keys are available:

←	Before pressing RETURN a student may wish to erase an answer (or other input) he or she has just typed. Press the left-arrow key to move the cursor back to the left, character by character.
CONTROL X	Press the **X** key while holding down the CONTROL key to e**X**it from a lesson and return to the menu of available lessons. This option is available whenever the program is awaiting a keypress.
CONTROL Q	Press the **Q** key while holding down the CONTROL key to **Q**uit or leave the program. This results in the student's name being erased from memory, and the program is ready for another student to begin work. This option is available whenever the program is awaiting a keypress.
CONTROL O	Press the **O** key while holding down the CONTROL key to turn the sound cue **O**n or **O**ff. When turned on, the sound cue alerts the student to the need to press RETURN.
CONTROL J	Press the **J** key while holding down the CONTROL key to **J**ump over a learning objective. This option is available only when the objective title page appears on the screen.
CONTROL P	Press the **P** key while holding down the CONTROL key to obtain an additional set of **P**ractice items. This option is available only when it appears on the screen, at the end of an exercise set. A **CONTROL P** option also is available on the testing programs and provides the opportunity to **P**rint the results at the conclusion of each test.

Entering Fractions

There will be times when the answer a student needs to enter will be a fraction.

The following procedure allows the student to enter fractions easily:

1. Type - (minus sign) if the fraction is negative.

2. Type the numerator.

3. Type / (slash).

4. Type the denominator.

5. Press RETURN.

The desired fraction will then be correctly displayed on the screen.

Lesson Design 2

The format of all three lessons in **Quadratic Equations** is alike. Each lesson addresses one or more objectives. Each objective, in turn, deals with a different skill or concept in a logical series of steps.

When the menu page appears, the student selects the lesson to be taken. This takes the student to the first objective. The student may press RETURN to select this objective or skip to the next objective by using CONTROL J. CONTROL J may be repeated until the student reaches the desired objective.

All of the lessons follow the same general pattern. For each objective in each lesson, at least one tutorial example is provided to illustrate the concept or skill to be learned. This is followed by an interactive practice drill with appropriate feedback. Each lesson in **Quadratic Equations** has its own objectives and sequence of events.

Each objective, including practice exercises, takes a student approximately 10 to 20 minutes to complete depending on familiarity with the concept presented.

Lesson 1 - Special Cases

Lesson Sequence

Objective 1a: *Solve quadratic equations of the form:* $ax^2 \pm bx = 0$.

1. It is noted that a product is equal to 0 whenever one or both of its factors is 0. That is,

$$A \cdot B = 0$$
$$\text{if and only if}$$
$$A = 0 \text{ or } B = 0 \text{ or both } A = 0 \text{ and } B = 0$$

2. An example is presented for objective 1a that shows how to use the factoring method for finding the solutions:

$$x^2 - 6x = 0$$
$$x(x - 6) = 0$$

$$x = 0 \quad \text{or} \quad x - 6 = 0$$
$$\downarrow \qquad\qquad \downarrow$$
$$x = 0 \qquad\qquad x = 6$$

3. A five-problem interactive drill is presented. Appropriate corrective feedback based on the concepts introduced in the example is provided as necessary.

4. A report showing the student's performance on the drill is displayed, and the student is given an opportunity to continue or elect a second drill on the same objective. After the second drill, the lesson continues.

Objective 1b: *Solve quadratic equations of the form:* $x^2 - a^2 = 0$.

5. An example is presented for objective 1b that illustrates the factoring method for finding the solutions:

$$y^2 - \frac{1}{16} = 0$$

$$y^2 - \left(\frac{1}{4}\right)^2 = 0$$

$$\left(y - \frac{1}{4}\right)\left(y + \frac{1}{4}\right) = 0$$

$$y - \frac{1}{4} = 0 \quad \text{or} \quad y + \frac{1}{4} = 0$$

$$\downarrow \qquad\qquad \downarrow$$

$$y = \frac{1}{4} \qquad\qquad y = -\frac{1}{4}$$

6. A five-problem interactive drill is presented. Appropriate corrective feedback based on the concepts introduced in the example is provided as necessary.

7. A report showing the student's performance on the drill is displayed, and the student is given an opportunity to elect a second drill on the same objective or return to the menu of lessons. After the second drill, the lesson returns to the menu.

Lesson 2 - The General Case

Lesson Sequence

> ***Objective 2a:*** *Factorable Forms with Two Solutions - Solve quadratic equations that are factorable over the integers.*

1. Two examples are presented for objective 2a that show how to use the factoring method for finding the solutions:

$$x^2 - 3x + 2 = 0$$
$$(x - 2)(x - 1) = 0$$
$$x - 2 = 0 \quad \text{or} \quad x - 1 = 0$$
$$\downarrow \qquad\qquad \downarrow$$
$$x = 2 \qquad\qquad x = 1$$

$$y^2 - 5y = 6$$
$$y^2 - 5y - 6 = 0$$
$$(y - 6)(y + 1) = 0$$
$$y - 6 = 0 \quad \text{or} \quad y + 1 = 0$$
$$\downarrow \qquad\qquad \downarrow$$
$$y = 6 \qquad\qquad y = -1$$

2. A five-problem interactive drill is presented. Appropriate corrective feedback based on the concepts introduced in the examples is provided as necessary.

3. A report showing the student's performance on the drill is displayed, and the student is given an opportunity to continue or elect a second drill on the same objective. After the second drill, the lesson continues.

Objective 2b: *Factorable Forms with One Solution - Solve quadratic equations that are factorable as perfect squares.*

4. An example is presented for objective 2b in which the factoring method for solving the equation is illustrated:

$$k^2 - 4k + 4 = 0$$
$$(k - 2)(k - 2) = 0$$
$$k - 2 = 0$$
$$k = 2$$

5. It is noted that 2 is the only solution for this equation. Quadratic equations of this type have only one solution.

6. A four-problem interactive drill is presented. Appropriate corrective feedback based on the concepts introduced in the example is provided as necessary.

7. A report showing the student's performance on the drill is displayed, and the student is given an opportunity to elect a second drill on the same objective or return to the menu of lessons. After the second drill, the lesson returns to the menu.

Lesson 3 – The Quadratic Formula

Lesson Sequence

Objective 3a: *Solve quadratic equations using the quadratic formula.*

1. The quadratic formula is presented and it is noted that it can be used to solve every quadratic equation.

$$ax^2 + bx + c = 0$$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2. Two examples are presented for objective 3a that show how to use the quadratic formula:

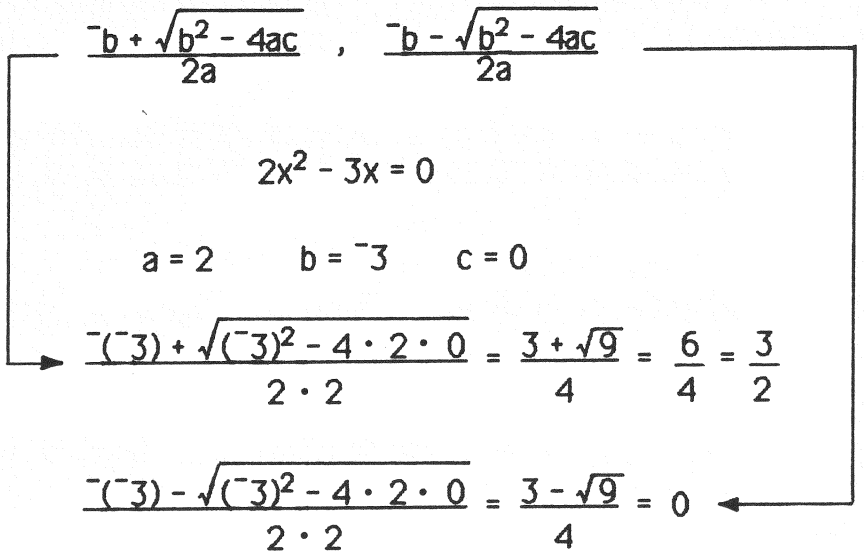
$$\frac{-b + \sqrt{b^2 - 4ac}}{2a} \quad , \quad \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

$$x^2 + 3x - 10 = 0$$

$$a = 1 \qquad b = 3 \qquad c = -10$$

$$\frac{-3 + \sqrt{3^2 - 4 \cdot 1 \cdot -10}}{2 \cdot 1} = \frac{-3 + \sqrt{49}}{2} = 2$$

$$\frac{-3 - \sqrt{3^2 - 4 \cdot 1 \cdot -10}}{2 \cdot 1} = \frac{-3 - \sqrt{49}}{2} = -5$$


$\frac{-b + \sqrt{b^2 - 4ac}}{2a}$, $\frac{-b - \sqrt{b^2 - 4ac}}{2a}$
$2x^2 - 3x = 0$
$a = 2 \quad b = -3 \quad c = 0$
$\frac{-(-3) + \sqrt{(-3)^2 - 4 \cdot 2 \cdot 0}}{2 \cdot 2} = \frac{3 + \sqrt{9}}{4} = \frac{6}{4} = \frac{3}{2}$
$\frac{-(-3) - \sqrt{(-3)^2 - 4 \cdot 2 \cdot 0}}{2 \cdot 2} = \frac{3 - \sqrt{9}}{4} = 0$

3. A seven-problem, interactive, multiple-choice drill is presented. Appropriate corrective feedback based on the concepts introduced in the examples is provided as necessary.

4. A report showing the student's performance on the drill is displayed, and the student is given an opportunity to elect a second drill on the same objective or return to the menu of lessons. After the second drill, the lesson returns to the menu.

Teaching Strategies 3

The lessons in **Quadratic Equations** are designed to reinforce and supplement the teaching of algebra. The computer lessons, Student Workbook, and testing program offer the flexibility to meet a variety of individual and classroom needs. The following strategies offer some ideas for using these materials. Teachers and students are encouraged to vary these strategies or to develop additional uses for the lessons.

Classroom Integration

The materials in **Quadratic Equations** can be used for diagnosis, instruction, practice, testing, and review. The following steps suggest one possible sequence for using the lessons:

1. *Diagnosis* - Once the prerequisites have been mastered, the placement test on the flip side of the diskette can be used to determine which objectives a student needs to study.

2. *Instruction* - The tutorial aspects of the lessons can be used to supplement classroom instruction. The lessons can reinforce the teacher's presentations by presenting the skills and concepts through another medium.

3. *Practice* - The lessons can be taken more than once to practice and reinforce newly learned skills and concepts. The exercises in the Student Workbook can be assigned as a follow-up activity.

4. *Testing* - The mastery tests on the flip side of the diskette can be used to help the teacher determine whether or not a student has achieved mastery of an objective.

5. *Review* - The lessons can be used to review skills and concepts prior to a classroom examination or to assure the teacher or student that the required concepts and skills are understood prior to beginning a new unit of study.

Individual Support

Quadratic Equations can be used to meet individual student's needs in varied situations. The following are some of the ways that the lessons can be used:

- Provide all students in a classroom with an individual activity to supplement and support classroom activities.
- Provide individual drill and practice to students in need of extra help on a topic.
- Help a student catch up when he or she has missed a classroom presentation.
- Provide students computer-aided instruction to review the concepts in the topic.
- Provide opportunities for talented students who are not yet in an algebra class to accelerate their learning. The lessons provide an opportunity for these students to explore new ideas and challenges.

The lessons in **Quadratic Equations** are appropriate for repeated use. The practice problems in the interactive drills are randomly selected from a bank of problems that is four times greater than the number of items in the drill.

Using the Test Diskette

The tests on the flip side of the lesson diskette offer the teacher a tool for determining a student's level of achievement and for tracking a student's progress through the lessons in **Quadratic Equations**. The first test (Placement Check/Pre-test) can help the teacher determine which concepts a student needs to study and which concepts are already within the student's grasp. After the student completes the Placement Check/Pre-test, the program displays an Objective Mastery Record. This display identifies the objectives that the student has already mastered. The remaining tests (one for each lesson objective) can be used to test the student for mastery after taking the lessons. Refer to table 2 for a list of the testing options on the test diskette.

The placement test presents groups of three questions. Each group tests knowledge of one objective in the topic. The student's achievement level is judged to be satisfactory when he or she answers two out of three questions correctly. If the student answers the first two questions in the group correctly, the achievement level is satisfactory, and the test continues with questions on the next objective. If the student answers the first two questions incorrectly, the achievement level is unsatisfactory and the test continues with questions on the next objective. A third question is used when the student answers only one of the first two questions incorrectly.

The number of questions in each mastery test is shown in table 2. The mastery criterion is one item less than the potential number of questions. If the student misses two questions, the test automatically terminates. If the student achieves the mastery criterion without an error, the test terminates early.

The test diskette contains a bank of items, drawn randomly, for each objective addressed in the lessons.

The objectives are organized and numbered in the same sequence as they appear in the lessons.

Table 2. Test Disk Organization

Menu Selection	Obj. No.	Objective	Maximum Number of Test Items
A		Placement Check	15*
B	1a	Solve quadratic equations of the form: $ax^2 \pm bx = 0$.	5
C	1b	Solve quadratic equations of the form: $x^2 - a^2 = 0$.	5
D	2a	Factorable Forms with Two Solutions - Solve quadratic equations that are factorable over the integers.	5
E	2b	Factorable Forms with One Solution - Solve quadratic equations that are factorable as perfect squares.	4
F	3a	Solve quadratic equations using the quadratic formula.	5

*Refer to Using the Test Diskette in this section.

Scoring and Record Keeping

Quadratic Equations provides answer judging and scoring for all practice drills and tests.

A personal record sheet is provided in the Student Workbook for student use. It can be used to record individual progress through the lessons. Each time a student achieves mastery of an objective, he or she can shade in the appropriate square.

If a printer is attached to the computer that is used as a testing station, then it is possible to obtain a printed copy of the student's test report. This option can be accessed when the record form appears on the screen and the student receives the message to "shade the indicated cell(s) on your graph."

The sequence of events for obtaining the printout is as follows:

1. Press CONTROL P.

2. Message appears to "type your last name and press RETURN."

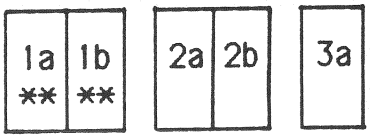
3. Message appears asking the student or teacher to make sure "the printer is on" and "the paper is positioned properly." Press RETURN.

4. A printout of the record form is made having the student's full name at the top of the form with the title of the diskette. Asterisks appear under any objective number for which the student has just demonstrated mastery.

Following is a sample of a printout generated after a student completed the placement check.

========== JANICE LASTNAME ==========

Quadratic Equations



==========

If the printer uses standard eleven-inch paper, the reports will be printed three per page with an ample amount of blank space left automatically between reports. There is no need to form feed between reports, and no report will overwrite the perforations between sheets of paper. For these features to work properly, your printer should be set to print ten characters per inch and six lines per inch. If there is an option for an automatic skip at form boundaries, this option should be turned OFF. Note: With an Apple II, II Plus, or IIe the printer must be attached at slot #1.

Supplementary Materials 4

The materials contained in this section are for use by the teacher and student. They include sample record sheets to record individual and class progress, a glossary of related terms, and practice sets to support each objective addressed in the lessons. In this manual, the answers are given on the practice sets. In the Student Workbook, the answers are not provided.

Additional copies of the Student Workbook are available so that each student can have his or her own individual set of supplementary materials. Refer to Distribution Information for ordering instructions.

Sample
Personal Record Sheet

Quadratic Equations
Objective Mastery Record

_____

Name

Shade in the correct box when mastery is achieved for that objective.

1a	1b	2a	2b	3a

_____ _____ _____ _____ _____

Date Completed

Sample
Class Record Sheet

Quadratic Equations
Objective Mastery Record

Student Name	Objectives					Date Complete
	1a	1b	2a	2b	3a	

Glossary

Quadratic Equation

Equations in the form

$$ax^2 + bx + c = 0$$

where a, b, and c are constants and $a \neq 0$, are quadratic.
For example, each of the following equations is quadratic:

$$x^2 - 7x + 6 = 0$$
$$3x^2 + x = 0$$
$$5x^2 - 20 = 0$$

Quadratic Formula

A formula for finding the solution(s) of a quadratic equation is a quadratic formula. For example, the solutions for:

$$ax^2 + bx + c = 0$$

are equal to:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Quadratic Equations

Lesson 1 - Special Cases

Name: _____ Date: _____

Practice Set 1 - Equations of the Form: $ax^2 \pm bx = 0$

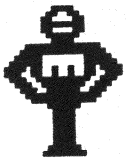
Example:

Name the two solutions of this equation.

$$4x^2 - x = 0$$

$$\downarrow$$

$$x(4x - 1) = 0$$



$x = 0$ or $4x - 1 = 0$

$4x = 1$

$x = 0$ $x = \frac{1}{4}$

The solutions are 0 and $\frac{1}{4}$.

Name the two solutions of each equation.

1. $y^2 - 3y = 0$ **0, 3**
2. $k^2 + 7k = 0$ **0, -7**
3. $d^2 + d = 0$ **0, -1**
4. $6b^2 + 3b = 0$ **0, $-\frac{1}{2}$**

5. $3c^2 - 3c = 0$ **0, 1**

6. $4x^2 + 2x = 0$ **0, $-\frac{1}{2}$**

7. $5p^2 - 10p = 0$ **0, 2**

8. $2y^2 - 4y = 0$ **0, 2**

9. $5x^2 - 2x = 0$ **0, $\frac{2}{5}$**

10. $7b^2 - b = 0$ **0, $\frac{1}{7}$**

11. $p^2 + 8p = 0$ **0, -8**

12. $3y^2 + y = 0$ **0, $-\frac{1}{3}$**

13. $8x^2 + 2x = 0$ **0, $-\frac{1}{4}$**

14. $k^2 - k = 0$ **0, 1**

Quadratic Equations

Lesson 1 - Special Cases

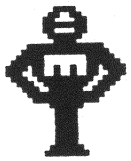
Name: _____ Date: _____

Practice Set 2 - Equations of the Form: $x^2 - a^2 = 0$

Example:

Name the two solutions of this equation.

$$x^2 - 4 = 0$$
$$\downarrow$$
$$x^2 - 2^2 = 0$$
$$\downarrow$$
$$(x - 2)(x + 2) = 0$$
$$x - 2 = 0 \quad \text{or} \quad x + 2 = 0$$
$$x = 2 \qquad\qquad x = {}^-2$$



The solutions are 2 and $^-2$.

Name the two solutions of each equation.

1. $y^2 - 25 = 0$ — 5, $^-5$
2. $k^2 - 16 = 0$ — 4, $^-4$
3. $b^2 - \frac{1}{4} = 0$ — $\frac{1}{2}$, $-\frac{1}{2}$
4. $p^2 - 4 = 0$ — 2, $^-2$

5. $x^2 - 9 = 0$ — $3, -3$

6. $b^2 - \frac{1}{9} = 0$ — $\frac{1}{3}, -\frac{1}{3}$

7. $k^2 - 64 = 0$ — $8, -8$

8. $x^2 - 49 = 0$ — $7, -7$

9. $y^2 - 36 = 0$ — $6, -6$

10. $x^2 - \frac{1}{25} = 0$ — $\frac{1}{5}, -\frac{1}{5}$

11. $k^2 - 1 = 0$ — $1, -1$

12. $p^2 - 81 = 0$ — $9, -9$

13. $x^2 - 100 = 0$ — $10, -10$

14. $b^2 - 1 = 0$ — $1, -1$

15. $k^2 - \frac{1}{64} = 0$ — $\frac{1}{8}, -\frac{1}{8}$

16. $y^2 - \frac{1}{100} = 0$ — $\frac{1}{10}, -\frac{1}{10}$

Quadratic Equations

Lesson 2 – The General Case

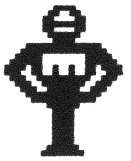
Name: _____ Date: _____

Practice Set 1 – Factorable Forms: Two Solutions

Example:

Name the two solutions of this equation.

$$x^2 - 3x + 2 = 0$$



$$(x - 1)(x - 2) = 0$$

$$x - 1 = 0 \quad \text{or} \quad x - 2 = 0$$

$$x = 1 \qquad\qquad x = 2$$

The solutions are 1 and 2.

Name the two solutions of each equation.

1. $k^2 + 3k - 4 = 0$ ____$^{-}4,\ 1$____
2. $y^2 + 4y + 3 = 0$ ____$^{-}3,\ ^{-}1$____
3. $b^2 - b - 6 = 0$ ____$3,\ ^{-}2$____
4. $p^2 - 7p + 12 = 0$ ____$3,\ 4$____
5. $x^2 - 4x - 12 = 0$ ____$6,\ ^{-}2$____

6. $y^2 + 5y + 6 = 0$ $^{-}2, ^{-}3$

7. $k^2 - 6k - 16 = 0$ $^{-}2, 8$

8. $x^2 - 6x + 8 = 0$ $4, 2$

9. $p^2 - 3p = 4$ $^{-}1, 4$

10. $b^2 - 10 = 3b$ $5, ^{-}2$

11. $x^2 + x = 20$ $4, ^{-}5$

12. $y^2 - 14 = 5y$ $7, ^{-}2$

Quadratic Equations

Lesson 2 – The General Case

Name: _____ Date: _____

Practice Set 2 – Factorable Forms: One Solution

Example:

Name the solution of this equation.

$$p^2 - 8p + 16 = 0$$

$$(p - 4)(p - 4) = 0$$
$$p - 4 = 0$$
$$p = 4$$

The solution is 4.

Name the solution of each equation.

1. $x^2 + 6x + 9 = 0$ $\quad -3$
2. $k^2 - 10k + 25 = 0$ $\quad 5$
3. $4y^2 + 12y + 9 = 0$ $\quad -\frac{3}{2}$
4. $d^2 - 18d + 81 = 0$ $\quad 9$
5. $y^2 - 2y + 1 = 0$ $\quad 1$

6. $16d^2 + 16d + 4 = 0$ $-\frac{1}{2}$

7. $9x^2 - 6x + 1 = 0$ $\frac{1}{3}$

8. $25p^2 + 20p + 4 = 0$ $-\frac{2}{5}$

9. $b^2 + 49 = 14b$ 7

10. $k^2 + 16k = {}^-64$ $^-8$

Lesson 3 - The Quadratic Formula

Name: _____ Date: _____

Practice Set 1 - The Quadratic Formula

Rule:

To find the solution of a quadratic equation of the form:

$$ax^2 + bx + c = 0,$$

the quadratic formula can be used:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Example:

Find the solutions of this equation.

$$x^2 + 5x + 4 = 0$$

$$a = 1 \quad b = 5 \quad c = 4$$

$$x = \frac{-5 \pm \sqrt{25 - 4 \cdot 1 \cdot 4}}{2 \cdot 1}$$

$$x = \frac{-5 + \sqrt{9}}{2} \qquad x = \frac{-5 - \sqrt{9}}{2}$$

$$x = -1 \qquad x = -4$$

Find the solutions of each equation.

1. $x^2 + 3x - 4 = 0$ $\quad 1, \ -4$
2. $3y^2 + 5y + 2 = 0$ $\quad -\frac{2}{3}, \ -1$
3. $k^2 + 4k + 3 = 0$ $\quad -1, \ -3$
4. $b^2 - 3b = 0$ $\quad 3, \ 0$
5. $5y^2 + 2y = 0$ $\quad 0, \ -\frac{2}{5}$
6. $-9k^2 + 16 = 0$ $\quad -\frac{4}{3}, \ \frac{4}{3}$
7. $n^2 + 2n - 15 = 0$ $\quad -5, \ 3$
8. $x^2 + 7x + 10 = 0$ $\quad -2, \ -5$
9. $b^2 - 7b + 5 = 0$ $\quad \frac{7 \pm \sqrt{29}}{2}$
10. $x^2 + 3x - 1 = 0$ $\quad \frac{-3 \pm \sqrt{13}}{2}$
11. $k^2 + 5k + 2 = 0$ $\quad \frac{-5 \pm \sqrt{17}}{2}$
12. $3y^2 - 5y - 1 = 0$ $\quad \frac{5 \pm \sqrt{37}}{6}$
13. $c^2 - 3c - 2 = 0$ $\quad \frac{3 \pm \sqrt{17}}{2}$
14. $3b^2 + 5b + 1 = 0$ $\quad \frac{-5 \pm \sqrt{13}}{6}$
15. $n^2 + 7n - 3 = 0$ $\quad \frac{-7 \pm \sqrt{61}}{2}$
16. $2p^2 - p - 5 = 0$ $\quad \frac{1 \pm \sqrt{41}}{4}$